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(54) **CONTROLLING CIRCUIT FOR ANALOG MEASUREMENT MODULE AND CONTROLLING MODULE THEREOF**

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G01R 15/22 (2006.01)

(52) **U.S. Cl.**
CPC ***G01R 15/22*** (2013.01)
USPC **327/306**; 327/356

(58) **Field of Classification Search**
USPC 327/306, 356
See application file for complete search history.

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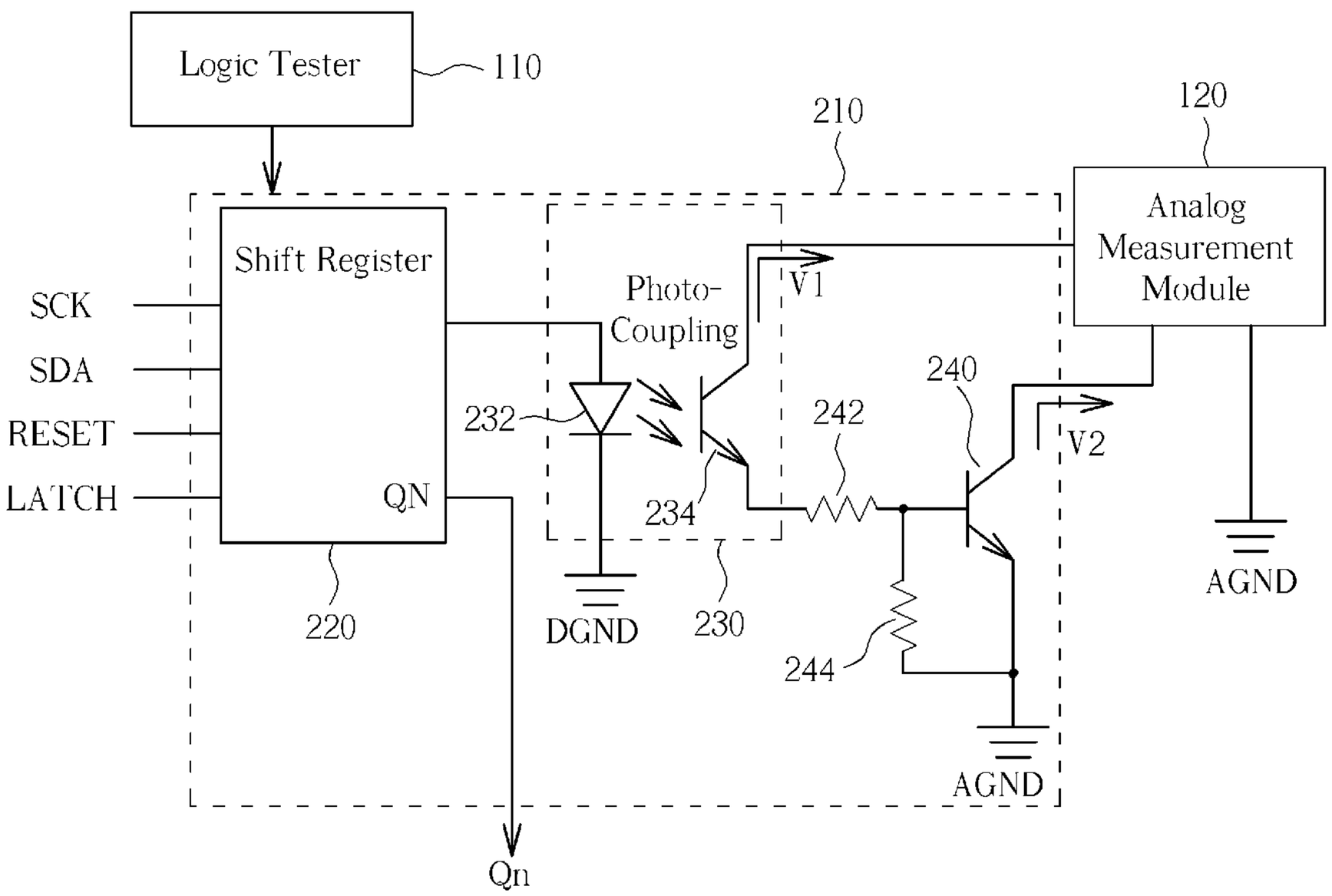
(57) **ABSTRACT**

In a controlling circuit, a photo coupler is used for isolating noises, and a general purpose amplifier is used for adjusting a gain, so that a logic tester may test analog signals in cooperation with relays having different specifications and operating voltage level differences in an analog measurement module. A shift register of each controlling circuit of a controlling module also transmits a test data signal to a next stage controlling circuit, so that a logic tester may simultaneously output a plurality of bits to multiple controlling circuits and multiple analog measurement modules by using merely one I/O port.

13 Claims, 3 Drawing Sheets



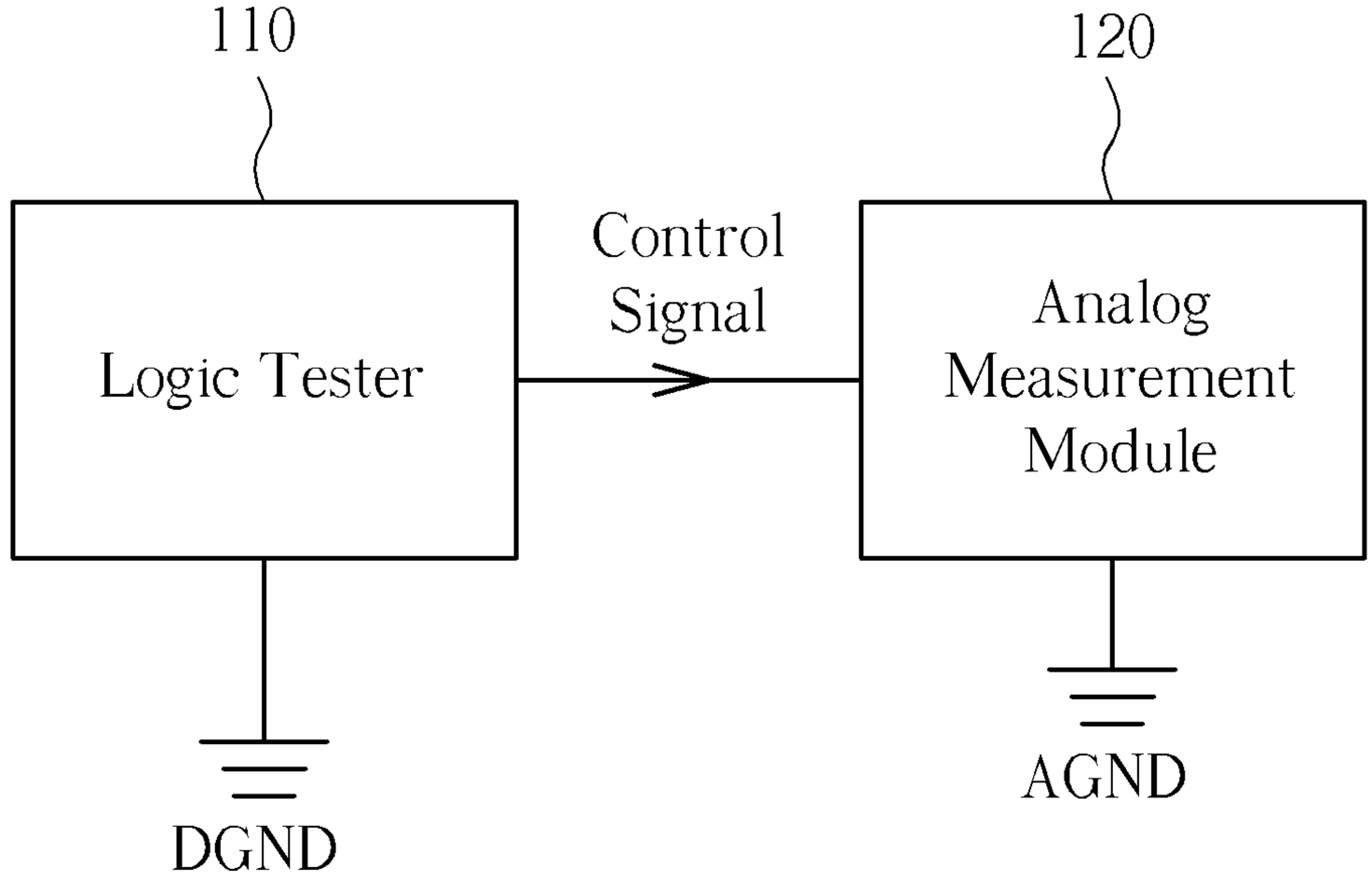


FIG. 1 PRIOR ART

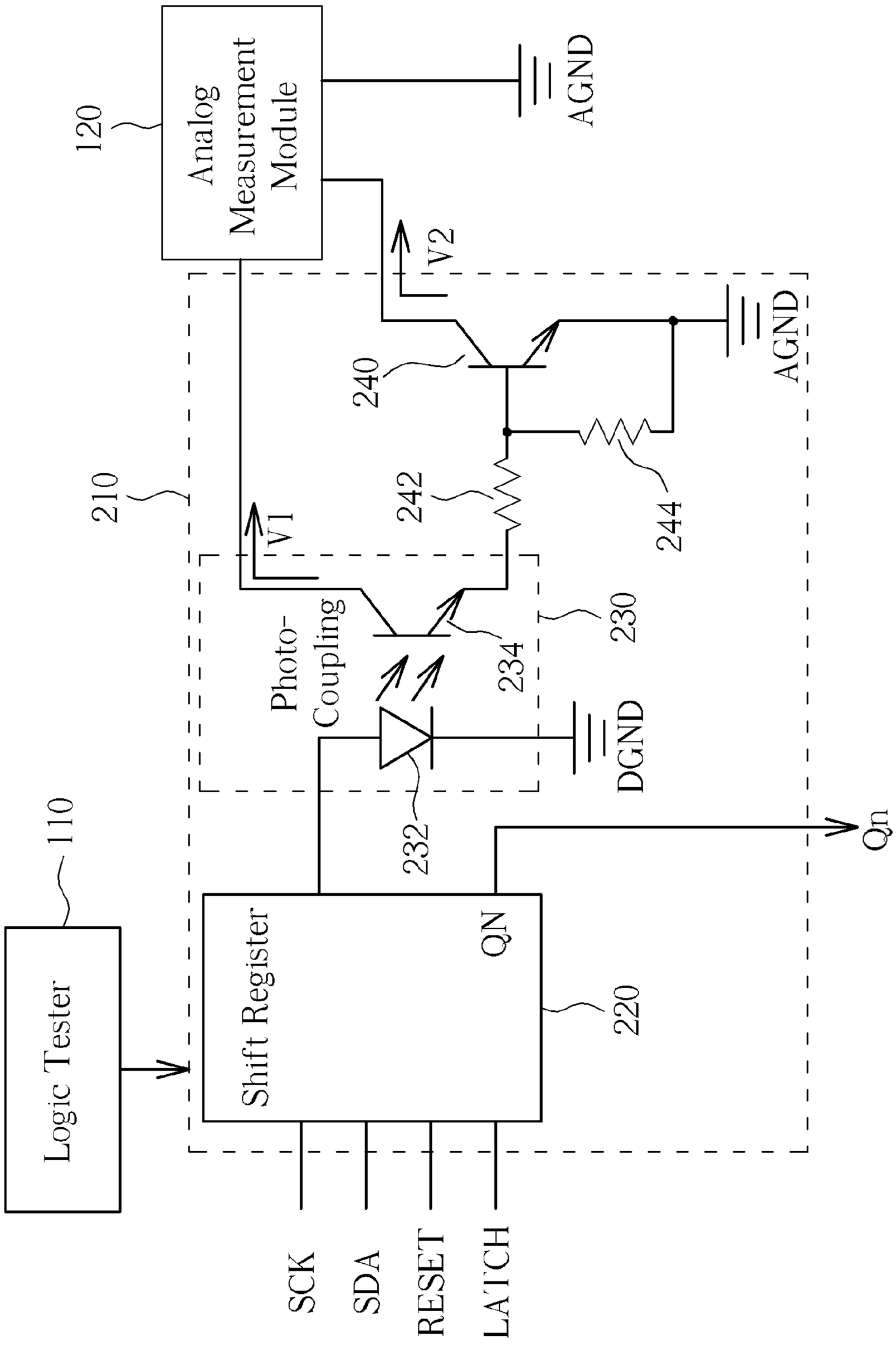

120
Analog Measurement Module
AGND
V2
210
240
AGND
242
244
V1
Photo-Coupling
234
230
232
DGND
Qn
110
Logic Tester
Shift Register
QN
220
SCK
SDA
RESET
LATCH

FIG. 2

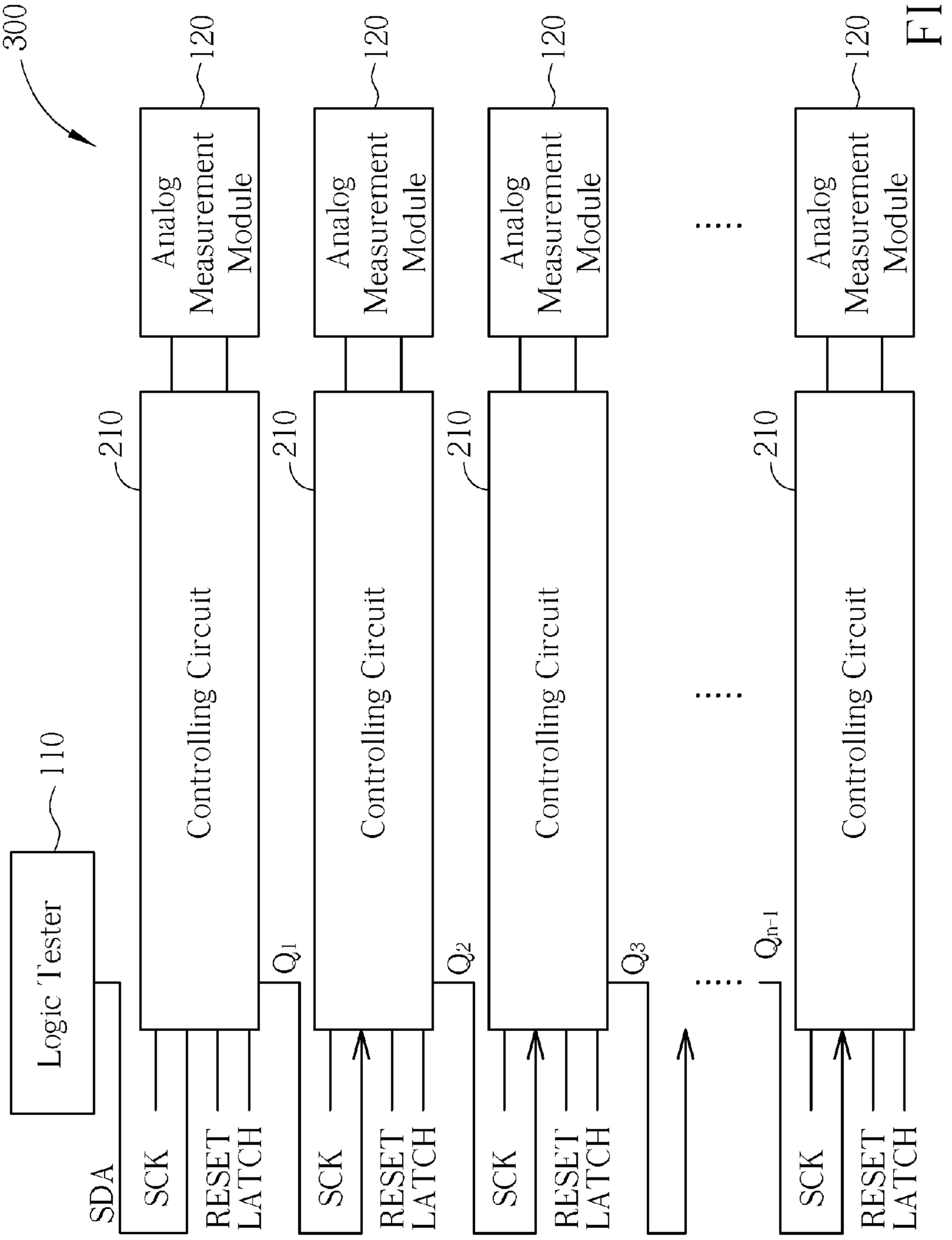

300
110
Logic Tester
SDA
SCK
RESET
LATCH
210
Controlling Circuit
120
Analog Measurement Module
Q_1
Q_2
Q_3
Q_{n-1}

FIG. 3

CONTROLLING CIRCUIT FOR ANALOG MEASUREMENT MODULE AND CONTROLLING MODULE THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention discloses a controlling circuit for an analog measurement module and a controlling module thereof, and more particularly, to a controlling circuit of isolating noises with the aid of a photo-coupler and of providing a required operating voltage level difference with the aid of a general purpose amplifier and a controlling module including at least one said controlling circuit.

2. Description of the Prior Art

Please refer to FIG. **1**, which illustrates a conventional logic tester **110** and an analog measurement module **120** in cooperation with the logic tester **110** for audio measurement. As shown in FIG. **1**, the logic tester **110** outputs a control signal to the analog measurement module **120** for measurement and test of AC small signals. The analog measurement module **120** is conventionally provided with a low-noise power, so as to reduce noise coupling from an external power. Since the analog measurement module is often required to test audio signals having different levels of magnitudes, the control signal from a single I/O port of the logic tester **110** is also required to be amplified in its magnitude with different gains, so as to retrieve audio signals having qualified magnitudes for testing. The analog measurement module **120** includes a relay, which is not illustrated herein for brevity, for serving as a switch for selecting amplifiers having different gains. The relay is capable of switching amplifiers having different gains according to a voltage level difference between an input control signal and a DC voltage source, so as to meeting requirements of audio signals having different ranges of magnitudes. The analog measurement module **120** is coupled to an analog ground AGND, and the logic tester **110** is coupled to a DC ground DGND. However, in considerations of various requirements of the analog measurement module **120** in its specifications, the requirements cannot be met by the logic tester **110** since said logic tester **110** can merely transmit control signals with a single I/O port. Besides, the control signal may be coupled to an analog measurement module **120** having unmatched specifications so that noises are introduced; and as a result, measurements of the analog measurement module **120** may be unstable or getting larger so that errors and higher fabrication capitals are both introduced.

SUMMARY OF THE INVENTION

The claimed invention discloses a controlling circuit for an analog measurement module. The controlling circuit comprises a shift register, a photo-coupler, and a general purpose amplifier. The shift register is used for receiving an external data signal, and for generating a plurality of bits according to the external data signal. The photo-coupler is coupled to the shift register, for transmitting the plurality of bits through photo-transmission. The general purpose amplifier is coupled to the photo-coupler, for receiving the transmitted plurality of bits from the photo-coupler, and for outputting the plurality of bits to an analog measurement module.

The claimed invention discloses a controlling system for an analog measurement module. The controlling system comprises a logic tester, at least one controlling circuit, and at least one analog measurement module. The logic tester is used for generating a test data signal. The at least one controlling circuit is coupled to the logic tester, for receiving the test data signal. The at least one analog measurement module is coupled to the at least one controlling circuit in a one-by-one correspondence. Each of the at least one analog measurement module is used for testing a corresponding element-under-test. The at least controlling circuit transmits the test data signal to the analog measurement module in a photo-transmission manner.

These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a conventional logic tester and an analog measurement module.

FIG. **2** is a schematic diagram of a controlling circuit of the present invention.

FIG. **3** illustrates a controlling system utilizing the controlling circuit shown in FIG. **2**.

DETAILED DESCRIPTION

For neutralizing the conventional problem that a logic tester merely has one single I/O port for outputting control signals so that the logic tester cannot meet various requirements in audio tests of a corresponding analog measurement module, a controlling circuit and a controlling module are disclosed in the present invention. The disclosed controlling circuit isolates noises in the control signal outputted from the logic tester with the aid of a photo-coupler, and adjusts a required gain of the control signal with the aid of a general purpose amplifier. The disclosed controlling module includes a plurality of the disclosed controlling circuit connected in series, so as to cooperate with analog measurement modules having different specifications.

Please refer to FIG. **2**, which is a schematic diagram of a controlling circuit **210** of the present invention, where the controlling circuit **210** cooperates with the logic tester **110** shown in FIG. **1**. The controlling circuit **210** includes a shift register **220**, a photo-coupler **230**, a general purpose amplifier **240**, and resistors **242** and **244**.

As shown in FIG. **2**, the shift register **220** is used for receiving four signals including a clock signal SCK, a data signal SDA, a reset signal RESET, and a switch signal LATCH, where the data signal SDA is generated according to the test data signal transmitted from the logic tester **110**. The shift register **220** transforms the data signal SDA into a plurality of bits in forms of high/low voltage levels.

The photo-coupler **230** includes a first sensing element **232** and a second sensing element **234**. The first sensing element **232** has a first terminal coupled to the shift register **220** for receiving the plurality of buts, and a second terminal coupled to the digital ground DGND. Whether the first sensing element **232** is triggered is determined according to the plurality of bits. The second sensing element **234** is coupled to the first sensing element **232** with a photo-coupling, so that the plurality of bits received by the first sensing element **232** can be transmitted to the second sensing element **234** by means of photo-transmission. The second sensing element **234** has a first terminal coupled to the analog ground AGND through resistors **242** and **244**. The second sensing element **234** is used for sensing whether the first sensing element **232** is triggered by the plurality of bits, so as to generate a plurality of signals corresponding to the plurality of bits.

The general purpose amplifier **240** has a switch terminal coupled to the first terminal of the second sensing element **234** through the resistor **242** so as to receive the plurality of signals, and has a reference terminal coupled to the analog ground AGND. The general purpose amplifier **240** is activated according to the plurality of signals, and outputs a second voltage level signal V**2** at its output terminal according to whether said general purpose amplifier **240** is activated.

In a preferred embodiment of the present invention, the first sensing element **232** is a photo emitter, for receiving signals outputted from the shift register **220**, and for transforming the signals into photo signals; the second sensing element **234** is a photo sensor, for sensing the photo signals transformed by the first sensing element **232**, for correspondingly outputting a first voltage level signal V**1** to the analog measurement module **120**, and for outputting the plurality of signals, which correspond to the plurality of bits, to the general purpose amplifier **240**. The sensing element **234** includes an npn photo transmitter. While a bit having a high voltage level passing the first sensing element **232**, and when the second sensing element **234** senses said bit, the general purpose amplifier **240** is activated according to said bit. Otherwise, while a bit having a low voltage level passing the first sensing element **232**, and when the second sensing element **234** senses said bit, the general purpose amplifier **240** is switched off according to said bit as well. The second sensing element **234** has a second terminal for outputting the first voltage level signal V**1** to the relay of the analog measurement module **120**, according to the voltage level indicated by the sensed bit. At last, a voltage level difference between the first voltage level signal V**1** and the second voltage level signal V**2** is used for operating the replay of the analog measurement module **120**.

In one embodiment of the present invention, the general purpose amplifier is an npn bipolar junction transistor, which is specifically configured to carry a current being larger than 100 mA in its magnitude, so as to meet requirements of the analog measurement module **120** under a higher gain or a larger current. Therefore, while the second sensing element **234** senses a high-voltage-level bit received by the first sensing element **232** and generates a high-voltage-level signal correspondingly, the general purpose amplifier **240** is activated by the high-voltage-level signal from the second sensing element **234**, so that a voltage level of the second voltage level signal V**2** is lowered to be close to the analog ground AGND; as a result, the voltage level difference between the first voltage level signal V**1** and the second voltage level signal V**2** is raised so as to meet requirements of a relay requiring a higher voltage level difference. On the contrary, while the second sensing element **234** senses a low-voltage level bit received by the first sensing element **232**, the general purpose amplifier **240** is correspondingly switched off, so that the second voltage level signal V**2** outputted from the general purpose amplifier **240** is maintained at a high voltage level because of being isolated from the analog ground AGND; and as a result, the voltage level difference between the first voltage level signal V**1** and the second voltage level signal V**2** is lowered so as to meet requirements of a relay requiring a smaller voltage level difference.

Besides, since the first sensing element **232** is coupled to the second sensing element **234** in a photo-coupling manner, even if there are noises in the plurality of bits, which are generated from the logic tester **110** and the shift register **220** and pass through the first sensing element **232**, said noises are isolated by the photo coupler **230** so that said noises cannot reach the second sensing element **234**.

Please refer to FIG. **3**, which illustrates a controlling system **300** utilizing the controlling circuit **210** shown in FIG. **2**. As shown in FIG. **3**, at least one controlling circuit **210** is connected to each other through an output signal Qn outputted from an output terminal QN of the shift register **220**, therefore, each of the at least one controlling circuit **210** is capable of transmitting a signal to activate a next-stage controlling circuit **210** while receiving the data signal SDA or one of the output signals Q_1, Q_2, Q_3, . . . , Q_{n-1}. Relays of at least one analog measurement module **120**, each of which is coupled to a corresponding controlling circuit **210** and is shown in FIG. **3**, are different in required voltage level differences and specifications. However, with the aid of the controlling circuit **210** shown in FIG. **2**, noises can be effectively isolated, besides, a purpose of cooperating with relays having different specifications and operating voltage level differences can also be fulfilled by utilizing general purpose amplifiers **240** having different gains. Moreover, since the at least one controlling circuit **210** is connected to each other, the logic tester **110** can be prevented from utilizing multiple I/O ports for coupling to each of the at least one controlling circuit **210** and each of the at least one analog measurement module **120**; instead, the logic tester **110** is capable of merely utilizing one single I/O port for simultaneously controlling multiple controlling circuits **210** and multiple analog measurement modules **120**.

The present invention discloses a controlling circuit and a controlling module thereof. A logic tester is capable of cooperating with relays having different specifications and different operating voltage level differences with the aid of a photocoupler, which is used for transmitting bits and isolating noises, and a general purpose amplifier, which is used for adjusting a required gain. Besides, a shift register of each of the at least one controlling circuit in the controlling module is used for transmitting a data signal to a next-stage controlling circuit one-by-one, so that the logic tester is capable of simultaneously outputting a plurality of bits to at least one controlling circuit and at least one analog measurement module, which correspond to the at least one controlling circuit in a one-by-one correspondence, by utilizing merely one I/O port.

Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention.

What is claimed is:

1. A controlling circuit for an analog measurement module, comprising:

a shift register for receiving an external data signal, and for generating a plurality of bits according to the external data signal;

a photo-coupler coupled to the shift register for transmitting the plurality of bits through photo-transmission; and

a general purpose amplifier coupled to the photo-coupler for receiving the transmitted plurality of bits from the photo-coupler, and for outputting the plurality of bits to an analog measurement module.

2. The controlling circuit of claim **1**, wherein the photo-coupler comprises:

a first sensing element coupled to a digital ground, the first sensing element receiving the plurality of bits transmitted from the shift register and transforming the plurality of bits into corresponding photo signals; and

a second sensing element coupled between the first sensing element and an analog ground, the second sensing element generating a first voltage level signal according to the photo signals corresponding to the transformed plurality of bits.

3. The controlling circuit of claim **2**,

wherein the first sensing element has a first terminal connected to the shift register so as to receive the plurality of

bits, a second terminal connected to the digital ground, and whether the first sensing element is triggered is determined according to the plurality of bits;

wherein the second sensing element is coupled to the first sensing element in a photo-coupling manner;

wherein a first terminal of the second sensing element is coupled to the analog ground and a second terminal of the second sensing element outputs the first electrical signal; and

wherein the first sensing element senses whether the first sensing element is triggered by the plurality of bits, so as to generate a plurality of signals corresponding to the plurality of bits.

4. The controlling circuit of claim **3**,

wherein the general purpose amplifier includes a switch terminal coupled to the first terminal of the second sensing element so as to receive the plurality of signals, a reference terminal coupled to the analog ground, and an output terminal for outputting a second electrical signal;

wherein whether the general purpose amplifier is activated is determined according to the plurality of signals.

5. The controlling circuit of claim **4**, wherein the general purpose amplifier includes a npn bipolar junction transistor, the switch terminal of the general purpose amplifier is a base of the npn bipolar junction transistor, the reference terminal of the general purpose amplifier is an emitter of the npn bipolar junction transistor, and the output terminal of the general purpose amplifier is a collector of the npn bipolar junction transistor.

6. The controlling circuit of claim **4**, further comprising:

a first resistor having a first terminal coupled to the first terminal of the second sensing element, and a second terminal coupled to the switch terminal of the general purpose amplifier; and

a second resistor having a first terminal coupled to the second terminal of the first resistor, and a second terminal coupled to the analog ground.

7. A controlling system for an analog measurement module, comprising:

a logic tester for generating a test data signal;

at least one controlling circuit coupled to the logic tester for receiving the test data signal; and

at least one analog measurement module coupled to the at least one controlling circuit in a one-by-one correspondence, each of the at least one analog measurement module being used for testing a corresponding element-under-test;

wherein the at least controlling circuit transmits the test data signal to the analog measurement module in a photo-transmission manner.

8. The controlling system of claim **7**, wherein each of the at least one controlling circuit comprises:

a shift register for receiving the test data signal and generating a plurality of bits according to the test data signal;

a photo-coupler coupled to the shift register for transmitting the plurality of bits by photo-transmission; and

a general purpose amplifier coupled to the photo-coupler for receiving the plurality of bits from the photo-coupler and outputting the plurality of bits to a corresponding analog measurement module.

9. The controlling system of claim **8**, wherein the photo-coupler comprises:

a first sensing element coupled to a digital ground, the first sensing element receiving the plurality of bits transmitted from the shift register and transforming the plurality of bits into corresponding photo signals; and

a second sensing element coupled between the first sensing element and an analog ground, the second sensing element generating a first voltage level signal according to the photo signals corresponding to the plurality of bits.

10. The controlling system of claim **9**,

wherein the first sensing element includes a first terminal connected to the shift register so as to receive the plurality of bits, a second terminal connected to the digital ground;

wherein whether the first sensing element is triggered is determined according to the plurality of bits;

wherein the second sensing element is coupled to the first sensing element in a photo-coupling manner, which has a first terminal coupled to the analog ground, a second terminal for outputting the first electrical signal, and wherein the second sensing element senses whether the first sensing element is triggered by the plurality of bits, so as to generate a plurality of signals corresponding to the plurality of bits.

11. The controlling system of claim **10**,

wherein the general purpose amplifier includes a switch terminal coupled to the first terminal of the second sensing element so as to receive the plurality of signals, a reference terminal coupled to the analog ground, an output terminal for outputting a second electrical signal;

wherein whether the general purpose amplifier is activated is determined according to the plurality of signals.

12. The controlling system of claim **11**, wherein the general purpose amplifier includes a npn bipolar junction transistor, the switch terminal of the general purpose amplifier is a base of the npn bipolar junction transistor, the reference terminal of the general purpose amplifier is an emitter of the npn bipolar junction transistor, and the output terminal of the general purpose amplifier is a collector of the npn bipolar junction transistor.

13. The controlling system of claim **11**, further comprising:

a first resistor having a first terminal coupled to the first terminal of the second sensing element, and a second terminal coupled to the switch terminal of the general purpose amplifier; and

a second resistor having a first terminal coupled to the second terminal of the first resistor and a second terminal coupled to the analog ground.

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